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Biological Aspects of Optimum Yield for
Georges Bank and Gulf of Maine Cod

Prepared by

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1.0 Georges Bank (Div. 5Z + SA6)

Biological data on historical trends and current status of the Georges Bank cod stock are contained in Woods Hole Lab. References 77-24, 78-03, 78-04, and 78-11. These documents summarized data on commercial and recreational catch statistics, research survey abundance indices, fishing mortality estimates, stock composition (numbers and biomass; age and length distribution), and recruitment. Additional biological information (mesh selection and yield per recruit analyses) is presented in the FMP for Atlantic Groundfish (NERFMC, April 1977).

Evaluation of the historical and present stock status revealed the following biological characteristics:

- 1) The present stock is dominated by the strong 1975 year-class. The autumn bottom trawl survey indicated that this year-class comprised 39% of the population, by number. Such dominance, by one year-class, has only previously been noted with the 1966 and 1971 year-classes. In absolute size the 1975 year-class at age 2 (beginning 1977) was estimated (from a commercial and recreational catch-survey regression) at about 31 million fish. Since 1960, only the 1966 and 1971 year-classes have exceeded this in size.
- 2) The 1975 year-class comprised 54% of the 1977 landings, by number (reported landings, discards not considered). The only occasion since 1960 when a single age-group comprised more of the catch than this was in 1973, when the 1971 year-class (age 2) comprised 65% of the landings.
- 3) Recruitment of the 1976 and 1977 year-classes was estimated to be below average and poor, respectively. The autumn bottom trawl surveys in 1976 and 1977 indicated that the catch-per-tow indices of the 1976 year-class at age 0 and age 1 were the lowest for these age-groups in the survey time series. A commercial and recreational catch-survey regression estimated the 1976 year-class at age 1 at 25.1 million fish, below the 1960-73 mean age 1 year-class size of 30.9 million fish. This technique tends to over-estimate year-class strength at low survey abundance levels. The 1977 year-class catch-per-tow index in the autumn 1977 survey was 0.02, the fifth lowest index in the survey series. Hence, this year-class was assumed to be poor in strength.
- 4) The exceptionally strong 1966 and 1971 year-classes contributed significantly to the fishery (and stock size) for only three years. Afterward, the relative component of these year-classes to stock size (number) was less than a below average year-class. Under similar conditions, the 1975 year-class may only contribute significantly to stock size until 1979.

5) Fishing mortality (F) in 1977 was estimated to be the following:

age 2 (1975 year-class): between $F=0.51-0.81$, depending on discard level

age 3 (1974 year-class): between $F=0.68-1.15$, depending on discard level

age 4 and older: $F = 0.45$

All values are above $F_{\max} = 0.30$. The age 2 and 3 F values are among the highest ever seen for these age groups in the fishery.

6) Total stock biomass (metric tons - age 1+), which decreased by about 50% from 1965-1976 (129,901 MT to 66,310) increased to about 80,000 MT in 1977 due to the growth-in-weight of the 1975 year-class. Spawning stock biomass (age 3 and older), which decreased by about 60% from 1965-1976 (109,575 MT to 45,382 MT), increased in 1977 to about 56,500 MT. At the start of 1978, total stock biomass was reduced to about 71,000 MT and spawning stock size to about 55,000 MT (given 30% discard level applied to 1977 commercial catches).

7) An analysis (1960-77) and projection to 1978 using only commercial data showed similar biomass trends as the analyses performed using both recreational and commercial data.

A 1978 OY of about 26,000 tons (22,000 US commercial + 4,000 for US recreational and Canadian allocation) will probably result in no increase (or no detectable increase) in total stock size in 1979, and a minor increase (<5%) in spawning stock size. This is generally true whether discards were assumed to be either 15 or 30% (by weight) of the 1977 commercial catch. However, if recreational catches were overestimated in previous years, stock declines may ensue from a 1978 harvest of 26,000 MT.

The resultant 1979 stock sizes, in all analyses, would remain higher than those seen in the most recent years (since 1972), but considerably below those observed from 1961-1971 (roughly 8-40% less).

2.0 Gulf of Maine (Div. 5Y)

Biological data on historical trends and current status of the Gulf of Maine cod stock are presented in Woods Hole Lab. References 77-24, 78-03, and 78-11. Detailed in these documents are data on commercial and recreational catch statistics, research survey abundance indices, survey size frequency distributions, and commercial landings size frequency distributions by market category. Additional biological information (historical ICNAF quotas, and survey-derived fishing mortality rate data) is contained in the FMP for Atlantic Groundfish (NERFMC, April 1977).

Evaluation of past and present stock conditions reveals the following biological characteristics:

1) Reported 1977 USA commercial landings (10,291 MT) were the highest in the history of fishery since 1945, and exceeded the annual long-term (1932-1975) average of 6,200 tons by about 66%, and the 1977 OY of 5,000 tons by 106%.

2) From 1973-1976, annual USA commercial landings increased sequentially by almost 1,000 tons a year. All annual values since 1974 exceeded the long-term average.

3) Both bottom trawl survey and commercial market category size composition data indicate that one strong year-class (1971) and two moderately strong year-classes (1973 and 1974) have appeared in the fishery since 1970. Cod in the Gulf of Maine are generally recruited to the commercial fishery at age 3, and hence both the 1973 and 1974 year-classes have already entered the commercial landings.

4) Recruitment of the 1975, 1976, and 1977 year-classes is estimated as poor, since catch-per-tow indices for these year-classes in the 1975-77 research surveys are among the lowest in the survey time series. These results imply that the currently exploited year-classes in the population will have to sustain the fishery through at least 1980.

5) The 1977 total catch-per-tow abundance index (pounds) rose sharply from that of 1976 (21.4 vs 9.2). Since recruitment indices since 1975 have been low, this increase probably reflects the growth-in-weight of the moderately strong 1974 year-class. The 1977 index, however, is still somewhat below the 1968-1971 mean catch-per-tow index (23.08), and the 1963 and 1964 values (24.4 and 31.0, respectively).

The 1978 Gulf of Maine cod OY of 8,500 MT (6,000 US commercial and 2,500 recreational) is equivalent to a fishing mortality of $F=0.31$, or approximately the F_{max} level ($F=0.30$). On a short term basis (i.e., 1 year), this level of fishing should not result in serious stock decline. If recreational catches were underestimated in previous years, the 1978 Gulf of Maine OY may, in fact, result in a stock biomass increase. Long-term continued fishing at the F_{max} level, however, will probably result in declines as has been evidenced in other northern cod stocks fished at F_{max} levels. The absence of significant recruitment during 1975-1977 suggests that stock biomass may start to decrease significantly during 1979.